NOTES ON THE VEGETATION OF THE MEXICAN STATE OF MORELOS

CHESTER M. ROWELL

Department of Biology, Texas Technological College, Lubbock[1]

During the summers of 1949 and 1950 the author and his students were privileged to make extensive observations and collections in the Mexican State of Morelos. The work was carried on as part of the summer field courses under the joint sponsorship of the departments of Wildlife Management and Biology of the Agricultural and Mechanical College of Texas. Some additional collections were made by the author in August of 1960.

The state of Morelos is located south of the Federal District in central Mexico. It is bounded on the north by the state of Mexico, and the Federal District, on the east by Pueblo, by Oaxaca on the south and Guerrero on the west. There is a variation of altitude within the state from approximately 17,800 ft. in the northeast to approximately 2,700 ft. in the southwest. The state boundary extends from the peak of the volcano Popocatepetl to the edge of the Balsas Basin.

The vegetation zones of Mexico as presented by Leopold (1959), and his terminology will be followed in general in this paper.

The flora of the state is divisible into two major types, temperate and tropical. Four of Leopold's vegetation types are found within the political limits of Morelos.

The temperate zone includes vegetational types: Pine-Oak Forest, Boreal Forest, and Alpine-Meadow. These vegetational types are found in the northern one-third of the state.

The Mixed Forest type or Pine-Oak Forest is characterized by open scattered stands of woodlands dominated by pines or oaks. Apparently dependent on the elevation and available moisture, either the pines or the oaks may assume dominance in any particular area and occasionally they are distributed almost equally. It is interesting to note that no distinct zone of oak-shrub was observed by the author in Morelos where this type merged with some of the more xeric types at lower elevations of approximately 9,000 and 6,500 ft.

The dominant members of the flora of the Pine-Oak Forest are: *Pinus montezumae, Pinus lawsonii, Pinus teocote, Quercus spp.* Other important members of the flora included in this type are: *Arbutus glandulosa, Ceanothus azureus, Buddleia americana.*

The Boreal Forest type is found in rather limited areas in the north portion of the state. It is characterized by coniferous forests with a

[1] Current temporary address: Department of Botany, Oklahoma State University, Stillwater.

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bunch grass or sacaton *(Festuca tolucensis)* ground cover. A humid environment is associated with this vegetational type and limits it in Morelos between the elevations of approximately 9,000 and 13,000 ft. Canyons at lower elevations which are subject to frequent fog conditions also exhibit this type of vegetation.

The more important species of this vegetational type include: *Pinus lawsonii, Pinus ayacahuite, Pinus leiophylla, Pinus teocote, Pinus montezumae, Pinus hartwegii, Abies religiosa, Festuca tolucensis.*

The third temperate vegetational type is the Alpine Meadow. To my knowldge it is found in Morelos only in the small area where the state line extends up the side of the volcano Popocatepetl. In this area, which is normally above timberline, there are extensive meadows of sacaton *(Festuca* spp.) with robust herbs such as *Lupinus* and *Castilleja.*

The tropical vegetation type found in the state is the Tropical Deciduous Forest with some variations. This type covers approximately the southern two-thirds of the state and is usually found below elevations of 6,500 ft.

This Tropical Deciduous Forest as observed in Morelos exhibits two rather distinct forms. One form is typical of that outlined by Leopold and the other, a more arid type, seems related to his Arid Tropical Shrub.

The typical Tropical Deciduous Forest type is found on the lower mountain slopes from approximately 6,500 to 4,000 ft. and in canyons at lower altitudes that have higher available moisture.

This type is predominantly composed of low, shrub-like trees and some of the larger cacti. The trees are usually leafless during the dry season, but are more abundant and larger than those of the more arid type.

The more important members of this type include the following: *Ipomea arborea, Juliana adstrungens, Bursera* spp., *Pseudosmodingium* spp., *Comocladia* spp., *Parchycereus marginata, Cephalocereus* spp.

The more arid form of the Tropical Deciduous Forest is usually found at elevations below 4,000 ft. It is characterized by sparse, thorny, low shrubs and cacti. The more important members of this type include the following: *Acacia farnesiana Acacia* spp., *Pithecolobium* spp., *Opuntia* spp., *Cephalocereus* spp., *Crescentia* spp., *Dodonaea viscosa, Lippia* spp., *Lantana* spp.

In the riparian associations along stream beds and in marsh lands the vegetation exhibits marked variations and includes such forms as: *Persea americana, Taxodium distichum, Ficus* spp., *Astianthus viminalis, Guazuma ulmifolia.*

Due to the extremes in ecological conditions as expressed through both altitudinal and moisture variations, Morelos exhibits remarkable variation in vegetation and as such presents a very interesting problem in floristics.

The following list of species is based on specimens collected in Morelos by the author and his students. Most of the determinations were made by the author using the facilities at the University of Michigan Herbarium. All species of the Verbenaceae were verified or determined by Dr. H. N. Moldenke. Dr. Rogers McVaugh verified the author's determinations of many species in the Leguminosae. It is hoped that this list will contribute to the sparse knowledge of the distribution of the Mexican flora.

For simplicity the species are arranged alphabetically by families, genera, and species. After each species the town nearest the collection site is listed plus a number in parenthesis indicating vegetation type. 1. Alpine Meadow; 2. Boreal Forest; 3. Pine-Oak Forest; 4. Tropical Deciduous Forest. Specimens on which these determinations were made are deposited at one or more of the following herbaria: S. M. Tracy Herbarium, Texas A. and M. College; The Herbarium, the University of Michigan; The Herbarium, Southern Methodist University.

ALISMATACEAE	
Sagittaria lancifolia L.	Cuautla (4)
AMARYLLIDACEAE	
Allium glandulosum Link and Otto	Cuautla (4)
Nothoscordum fragrans (Vent.) Kunth	Tres Cumbres (2)
Pancratium littorale Jacq.	Axochiapan, Cuernavaca (1)
APOCYNACEAE	
Haplophytum cimicidum A. DC.	Yautepec (1)
ASCLEPIADACEAE	
Asclepias grandiflora Fourn.	Yautepec (1)
BIGNONIACEAE	
Astianthus viminalis (H.B.K.) Baill.	Amacusac (1)
BOMBACACEAE	
Waltheria americana L.	Cuautla (1)
CARYOPHYLLACEAE	
Arenaria decussata Willd.	Lagunas de Zempoala (2)
COMMELINACEAE	
Commelina coelestis Willd.	Cuautla, Tlacotepec, Tres Cumbres, L. de Zempoala (2, 3)
Tradescantia commelinoides R. & S.	Lagunas de Zempoala (2)
COMPOSITAE	
Achillea millefolium L.	Lagunas de Zempoala (2)
Ageratum corymbosum Zucc.	Yautepec, Cuautla, Axochiapan (4)
Aphanostephus pachyrrhizus Shinners	Cuautla (4)
Aster Lima Lindl.	Axochiapan (4)
Conyza filaginoides (DC.) Hieron.	Cuautla (4)

Conyza sophiaefolia H.B.K.	Cuautla (4)
Dyssodia pinnata (Cav.) Robinson	Cuautla (4)
Erigeron maximus Link & Otto	Lagunas de Zempoala (2)
Erigeron scaposus DC.	Huitzilac, Cuautla, Tres Cumbres (2, 3)
Florestina pedata (Cav.) Cass.	Cuautla, Yautepec (4)
Florestina trifida DC.	Cuautla (4)
Florestina tripteris DC.	Cuautla, Yautepec, Axochiapan (4)
Galeana hastata Llave & Lex.	Tiacotepec (4)
Galinsoga aristulata Bicknell	Progreso (4)
Heterotheca inuloides Cass.	Cuautla (4)
Lagascea rubra H.B.K.	Cuautla (4)
Melampodium oblongifolium DC.	Axochiapan, Yautepec (4)
Melampodium paludosum H.B.K.	Yautepec, Cuautla (4)
Otopappus robustus Hemsley	Axochiapan (4)
Pectis latisquama Schultz	Cuautla (4)
Pinaropappus roseus Less.	Cuautla (4)
Sanvitalia procumbens Lam.	Axochiapan, Tlacotepec, Cuautla (4), Yautepec (4)
Sclerocarpus divaricatus (Bentham) B. & H.	Yautepec, Axochiapan (4)
Sclerocarpus uniserialis B. & H.	Axochiapan (4)
Spilanthes americana var. parvula (Rob.) A. H. Moore	Axochiapan (4)
Stevia serrata Cav.	Cuautla (4)
Tagetes filifolia Lag.	Cuautla (4)
Tagetes jaliscana Greenm.	Cuautla (4)
Tagetes lucida Cav.	Cuautla (4)
Tridax coronopifolia Hemsley	Cuautla Yautepec (4)
Tridax procumbens L.	Axochiapan (4)
Zexmenia aurea B. & H.	Tres Cumbres (2)
Zexmenia crocea Gray	Yautepec (4)
Zexmenia helianthoides (DC.) Gray	Yautepec (4)
Zinnia multiflora L.	Yautepec, Axochiapan, Cuautepec (4)
CRUCIFERAE	
Eruca sativa Mill.	Cuautla (3, 4)
CYPERACEAE	
Eleocharis nodulosa (Roth) Schultes	Cuautla (3)
ERICACEAE	
Vaccinium leucanthum Schlecht.	Lagunas de Zempoala (2)
HYPERICACEAE	
Hypericum pauciflorum H. B. K.	Cuautla (3)

LEGUMINOSAE	
Acacia angustissima (Mill.) Kuntze	Yautepec (4)
Acacia farnesiana (L.) Willd.	Axochiapan (4)
Acacia paniculata Willd.	Axochiapan (4)
Aeschynomene virginica (L.) B. S. P.	Progresso (4)
Astragalus strigulosus H. B. K.	Cuautla (4)
Brongniartia podalyrioides H. B. K.	Yautepec (4)
Calliandra grandiflora (L'Her.) Bentham	Cuautla (4)
Calliandra houstoniana (Mil.) Standley	Yautepec (4)
Calliandra penduliflora Rose	Yautepec (4)
Cassia occidentalis L.	Axochiapan, Cuautla (4)
Cassia uniflora Mill.	Axochiapan, Yautepec (4)
Cologania procumbens Kunth	Axochiapan (4)
Crotalaria mollicula H. B. K.	Yautepec (4)
Crotalaria pumila Ortega	Cuautla, Progresso (4)
Crotalaria vitellina Ker	Cuautla, Axochiapan (4)
Eysenhardtia polystachya (Ortega) Sarg.	Huitzilac, Cuautla (3)
Lupinus elegans H. B. K.	Lagunas de Zempoala (2)
Mimosa albida H. & B.	Yautepec (4)
Mimosa benthami Macbride	Cuautla (4)
Mimosa caerulea Rose	Cuautla (4)
Nissolia fruticosa Jacq.	Yautepec (4)
Nissolia hirsuta DC.	Cuautla (4)
Pachyrrhizus erosus (L.) Urban	Yautepec, Axochiapan (4)
Phaseolus atropurpureus Bentham	Yautepec (4)
Phaseolus coccineus L.	Cuautla (4)
Phaseolus heterophyllus Willd.	Cuautla (4)
Pisum sativum L.	Cuautla (4)
Rhynchosia pyramidalis (Lam.) Urban	Yautepec (4)
Tephrosis nicaraguensis Oerst.	Yautepec (4)
Trifolium amabile H. B. K.	Cuautla, Tres Cumbres (2, 3)
Zornia diphylla (L.) Pers.	Cuautla (3)
LILIACEAE	
Anthericum aurantiacum J. G. Baker	Yautepec (3, 4)
Bessera elegans Schult.	Yautepec (4)
Milla biflora Cav.	Cuautla (4)
LOASACEAE	
Mentzelia aspera L.	Yautepec, Cuautla (4
MALPIGHIACEAE	
Bunchosia palmeri S. Watson	Yautepec, Axochiapan, Cuautla (4)

MALVACEAE	
Anoda cristata (L.) Schl.	Cuautla, Axochiapan, Yautepec (4)
Anoda hastata Cav.	Progresso (4)
Malvastrum coromandelianum (L.) Garcke	Yautepec, Axochiapan (4)
Sida procumbens Sw.	Yautepec (4)
MARTYNIACEAE	
Martynia annua L.	Yautepec (3, 4)
MORACEAE	
Dorstenia drakena L.	Yautepec (4)
ONAGRACEAE	
Lopezia mexicana Jacq.	Cuautla (4)
POLYPODIACEAE	
Adiantum concinnum H. & B.	Cuautla, Yautepec, Axochiapan (4)
Adiantum kaulfussi Kunze	Cuautla (3)
Adiantum poireti Wikstr.	Cuautla (3)
Bommeria pedata (Swartz) Fournier	Cuautla (3)
Cheilanthes angustifolia H. B. K.	Cuautla (3)
Cheilanthes cucullans Fee	Cuautla (3)
Cheiloplecton rigidum (Swartz) Fee	Yautepec (4)
Notholaena aurea (Poir) Desv.	Cuautla (3)
Pellaea skinneri Hooker	Axochiapan (4)
Polypodium polypodioides (L.) A. S. Hitchcock var. aciculare Weatherby	Cuautla (3)
PONTEDERIACEAE	
Heteranthera limosa (Sw.) Willd.	Axochiapan (4)
RANUNCULACEAE	
Clematis drummondii T. & G.	Cuautla (3)
RHAMNACEAE	
Karwinskia umbellata (Cav.) Schlecht.	Amacusac (4)
RUBIACEAE	
Bouvardia ternifolia (Cav.) Schlecht.	Cuautla (3)
Cephalanthus salicifolia H. & B.	Cuautla (3)
Diodia tetracocca Hemsley	Cuautla (3)
Galium asperrimum Gray	Cuautla (3)
Paederia pringlei Greenman	Yautepec (topotype) (4)
Spermacoce haenkeana Hemsley	Cuautla (3)
Spermacoce patula M. & G.	Cuautla, Axochiapan, Huitzilac (3, 4)
SAPINDACEAE	
Cardiospermum halicacabum L.	Axochiapan (4)
Dodonaea viscosa Jacq.	Yautepec (4)

SCROPHULARIACEAE	
Castilleja pringlei Fern.	Lagunas de Zempoala Tres Cumbres (2)
Castilleja scorzoneraefolia H. B. K.	Cuautla, Lagunas de Zempoala (2, 3)
Castilleja tenuiflora Bentham	Cuautla, Huitzilac (3)
Mimulus glabratus (L.) Wettst.	Lagunas de Zempoala (2)
Pedicularis mexicana Zucc.	Lagunas de Zempoala (2)
Penstemon campanulatus Willd.	Yautepec, Cuautla, Tres Cumbres (3, 4)
Veronica americana (Raf.) Schwein.	Lagunas de Zempoala (2, 3)
SELAGINELLACEAE	
Selaginella pallescens (Pres.) Spring	Yautepec (4)
SOLANACEAE	
Nicotiana glauca Graham	Cuautla (3, 4)
Solanum bicolor Willd.	Cuautla (3)
Solanum nigrum L.	Lagunas de Zempoala (2)
STERCULIACEAE	
Ayenia montana Rose	Yautepec (4)
Melochia pyramidata L.	Cuautla (3, 4)
Physodium dubium Hemsley	Yautepec, Axochiapan (3, 4)
TURNERACEAE	
Turnera ulmifolia L.	Cuautla (4)
VERBANACEAE	
Bouchea prismatica (L.) Ktze.	Axochiapan (3)
Lantana achyranthifolia Desf.	Yautepec, Axochiapan, Cuautla (3, 4)
Lantana camara L.	Cuautla, Yautepec, Axochiapan (3, 4)
Lantana hispida H. B. K.	Yautepec (3, 4)
Lantana velutina H. B. K.	Cuautla, Axochiapan, Tlacotepec (3, 4) Yautepec (4)
Lippia berlandieri Schauer	Yautepec (4)
Vitex mollis H. B. K.	Cuautla (4)
VITACEAE	
Cissus subtruncata Rose	Yautepec (4)

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